Completed Element (2013 - 2014)

Advanced Manufacturing Technologies (AMT): Composites Integrated Modeling Element

Game Changing Development Program | Space Technology Mission Directorate (STMD)

ABSTRACT

The Composites Integrated Modeling (CIM) Element developed low cost, lightweight, and efficient composite structures, materials and manufacturing technologies with direct application to the proposed Space Launch System (SLS) Exploration Upper Stage (EUS) mission.

ANTICIPATED BENEFITS

To NASA funded missions:

This project was transitioned to the Composites for Exploration Upper Stage Project (CEUS) under the Technology Demonstration Program. The CEUS project will design, manufacture and test an aft upper stage LH2 tank skirt and a forward upper stage LH2 tank skirt. The two upper stage skirts will be 8.4m in diameter and tested in a relevant environment maturing the composites technology for this dry structure application to a TRL6.

DETAILED DESCRIPTION

CIM encompassed computational methods, tools and processes that go into the materials, design, manufacturing and qualification of composite aerospace structures. This effort proposed that test articles and analytical techniques be developed in order to investigate the appropriate treatment of model-based methods to achieve the maximum benefit of using the computational approaches for optimization of cost, performance, and reliability materials for launch vehicle structures such as the EUS.

Materials

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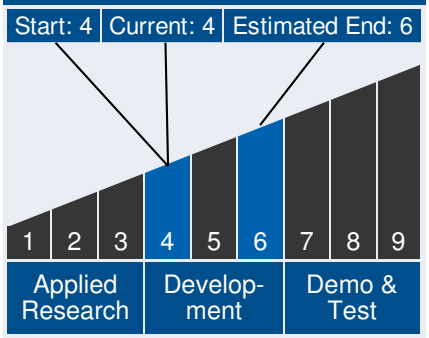
Technology Maturity



Management Team

Program Executive:

- Ryan Stephan

Program Manager:

- Stephen Gaddis

Continued on following page.

Advanced Manufacturing Technologies (AMT): Composites Integrated Modeling Element

- Extend use of out-of-autoclave materials to load-bearing composite structures
- Introduce damage-based allowables to improve performance while reducing cost
- Reduce allowables variability

Design

- Tailor composite wall construction to maximize load-carrying capability while minimizing mass
- Implement model-based integration of design and qualification/certification
- Reduce artificial knockdown factors by implementing damage-based allowables at a component level

Manufacturing

- Implement model-based, automated manufacturing of relevant-scale structures
- Demonstrate light-weight bonded joint technology to reduce numbers of fasteners

Management Team *(cont.)*

Project Manager:
- John Vickers

Principal Investigator:
- Lanetra Tate

Technology Areas

Primary Technology Area:
Materials, Structures, Mechanical Systems and Manufacturing (TA 12)
- Materials (TA 12.1)
  - Lightweight Structural Materials (TA 12.1.1)
    - Out Of Autoclave Material Systems Resins/Adhesives/Fibers (TA 12.1.1.1)

Additional Technology Areas:
Materials, Structures, Mechanical Systems and Manufacturing (TA 12)
- Materials (TA 12.1)
  - Computationally-Designed Materials (TA 12.1.2)
    - Predictive Computational Materials (TA 12.1.2.1)
    - Computational Materials Design (TA 12.1.2.2)

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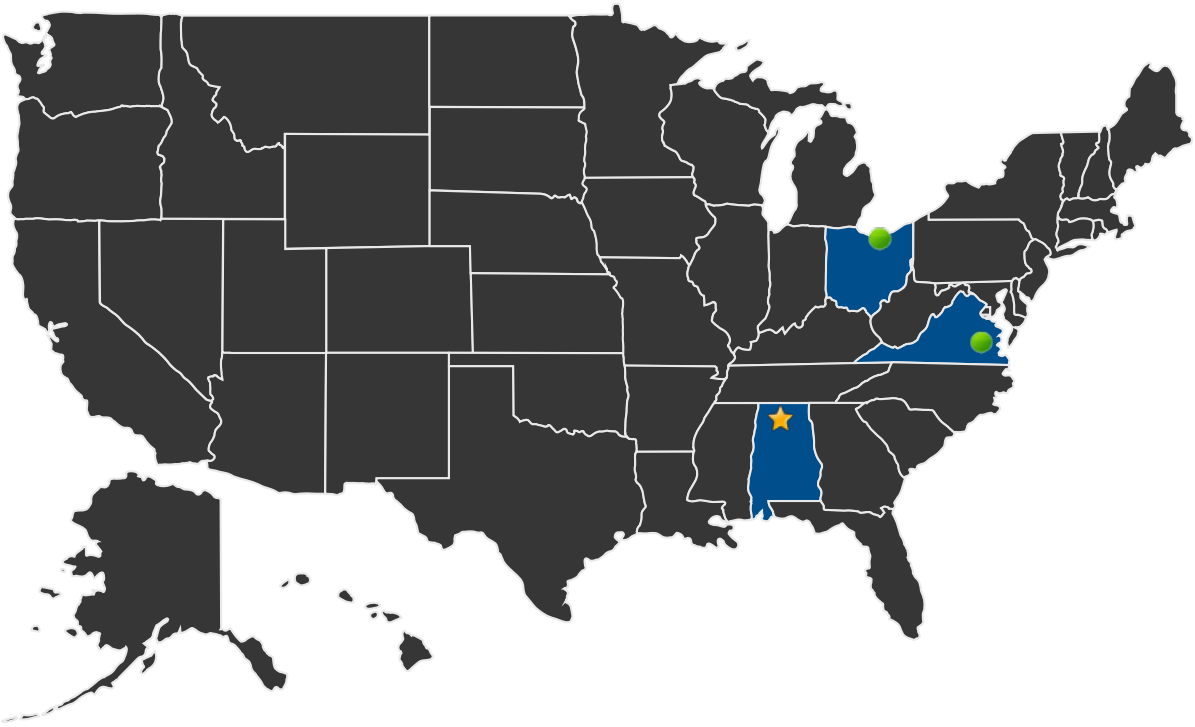
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Marshall Space Flight Center

Supporting Centers:

- Glenn Research Center
- Langley Research Center
- Marshall Space Flight Center

DETAILS FOR TECHNOLOGY 1

Technology Title

Advanced Manufacturing Technologies: Composites Integrated Modeling

Technology Description

This technology is categorized as a hardware system for ground scientific research or analysis

CIM encompassed computational methods, tools and processes that go into the materials, design, manufacturing and qualification of composite aerospace structures. This effort proposed that test articles and analytical techniques be developed in order to investigate the appropriate treatment of model-based methods to achieve the maximum benefit of using the computational approaches for optimization of cost, performance, and reliability materials for launch vehicle structures such as the EUS.

Materials

- Extend use of out-of-autoclave materials to load-bearing composite structures
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Manufacturing

- Implement model-based, automated manufacturing of relevant-scale structures
- Demonstrate light-weight bonded joint technology to reduce numbers of fasteners

Capabilities Provided

- Understanding of applicable computational methods, tools and processes
- Plan to design, manufacture and test 8.4m diameter scale composite structure in a relevant environment

Potential Applications

This project was transitioned to the Composites for Exploration Upper Stage Project (CEUS) under

the Technology Demonstration Program. The CEUS project will design, manufacture and test an aft upper stage LH2 tank skirt and a forward upper stage LH2 tank skirt. The two upper stage skirts will be 8.4m in diameter and tested in a relevant environment maturing the composites technology for this dry structure application to a TRL6.